We claim:

1. An optical amplifier comprising a photonic band gap structure, the structure comprising:

a solid core which is doped with rare-earth dopant atoms;

a cladding layer around the core and having a periodic lattice structure,

wherein the rare-earth doped core defines at least a first wavelength range over which stimulated emission can occurs after excitation caused by the introduction of pump light, and wherein the photonic band gap structure is designed to permit light having energy corresponding to the wavelength range to be transmitted only in selected directions,

wherein the selected directions comprise:

a first direction along the photonic band gap structure.

2. An amplifier as claimed in claim 1, wherein the selected directions comprise at least one second direction, wherein light transmitted along the at least one second direction is able to escape laterally from the photonic band gap structure.

3. An amplifier as claimed in claim 1, wherein the core comprises a glass core doped with Thulium atoms.

4. An amplifier as claimed in claim 1, wherein the core comprises a glass core doped with erbium atoms.

5. An amplifier as claimed in claim 1, wherein the cladding layer comprises a glass layer with passageways

running along the length of the structure of a material of different refractive index to the glass of the cladding layer.

6. An amplifier as claimed in claim 5, wherein the passageways are air passageways.

7. An amplifier as claimed in claim 1, wherein the cladding layer comprises a glass layer with localised defects having different refractive index to the refractive index of the glass along the length of the structure.

8. An amplifier as claimed in claim 1, wherein the first wavelength range corresponds to a channel wavelength for amplification by the amplifier, and wherein the photonic band gap structure is designed to prohibit the transmission of light having energy outside the first wavelength range.

9. A method of amplifying an optical signal using a photonic band gap structure having a rare-earth doped core and a cladding, the method comprising:

introducing a signal to be amplified and a pump signal into the structure;

constraining the photon emissions from the rare-earth atoms to take place in a plurality of directions, the directions comprising a first direction along the photonic band gap structure.

10. A method as claimed in claim 9, wherein the plurality of directions, other than the first direction, are each towards the cladding such that the emissions can escape from the structure.

11. A method as claimed in claim 9, wherein the photon emissions are constrained through suitable design of the photonic band gap structure.

12. An optical communications system comprising an amplifier as claimed in claim 1.

13. An optical communications system as claimed in claim 12 comprising a plurality of nodes interconnected by optical fiber spans, wherein at least one node is provided with the amplifier.

14. An optical communications system as claimed in claim 12 comprising a plurality of nodes interconnected by optical fiber spans, wherein at least one amplifier of claim 1 is provided at a location along at least one of the spans.